‘BIOMONITORING OF POLLUTION IN RIVER GODAVARI AT AMBAD TQ. DIST JALNA, MAHARASHTRA’

SYNOPSIS OF Ph. D. THESIS

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SYNOPSIS

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Introduction:

All living beings use water and it is an important component in earth ecosystem, biosphere and biogeochemical cycles (Adoni, 1985). Around the world, freshwater habitats are being subjected to increased levels of human disturbance (Saunders *et al.,* 2002). Rivers are the most important water resource in the world in general and in India in particular. Great civilizations developed along the bank of the river and even today most of the development has taken place in the cities or in the areas located near the rivers. The river provides water for the industry, agriculture, commercial, aquaculture and domestic purpose. Unfortunately the same rivers are being polluted by discharge of municipal sewage, industrial effluent and agricultural runoff causing irreversible ecological damage and health hazard (Meitei et al., 2004a). A recent assessment of the status of inland water ecosystems shows that globally most threatened river catchments are to be found in the Indian subcontinent (WCMC, 2000).

River pollution has already acquired a serious dimension in India, with most its India’s fourteen major, 55 minor and several hundred small rivers are facing acute water pollution problem. The degree of pollution is generally assessed by studying physical and chemical characteristics of the water bodies (Duran and Suicnz, 2007). Chemical analyses of water provide a good indicator of the chemical quality of the aquatic system but high cost of complex chemical analysis, complicated and time consuming procedures of sample preparation, analysts search for quicker and more specific methods. Biological assessment or Bio- monitoring is a valuable assessment tool that is receiving increased use in water quality monitoring programs of all types and is a useful alternative for assessing the ecological quality of aquatic ecosystems since biological communities integrate the environmental effects of water chemistry, in addition to the physical and geomorphologic

characteristics of Rivers and lakes (Stevenson and Pan, 1999). The use of biological material combined with analytical techniques, allows improvement of the sensitivity and accuracy of conventional chemical methods.

Biomonitoring or biological monitoring is defined as the systematic use of biological responses to evaluate (primarily anthropogenic) changes in the environment with the intent to use this information in a quality control programme (Brown, C., *et al*, 1996). Bio- monitoring involves the use of indicators, indicator species or indicator communities. The presence or absence of the indicator or of an indicator species or indicator community reflects environmental conditions. Biomonitoring not only acts as a supplement to the physicochemical and bacteriological characteristics, but also provides precious information about the overall health of a water body. The alterations produced in the physical and chemical status of the riverine ecosystem become recognizable through elasticity of the community structure of the organisms (Wilhm and Dorris, 1966, 1986; Cairns and Dickson, 1971).

Bio-monitoring is a valuable assessment tool that has been used in water quality monitoring programs of all types (Kennish, 1992) but biomonitoring can not entirely replace standard physic-chemical water quality methods, so standard physico-chemical water quality methods need to be carried out in conjunction with biomonitoring tools to comprehensively evaluate the health of freshwater ecosystems.

The advantages of biomonitoring together with physical and chemical parameters are well known:

- It reflects overall ecological integrity (biological, physical, and chemical)
- It provides a holistic measure of environmental conditions by integrating stresses over time, and
- The public understands that living organisms are good indicators of a ‘healthy environment’

Aquatic organisms, such as diatoms (Patrick, 1973; Stevenson and Lowe, 1986; Lowe and Pan, 1996; Stevenson and Pan, 2001) and benthic macro invertebrates such as fish, can serve as

bioindicators to integrate their total environment and their responses to complex sets of environmental conditions (Worf, 1980).

Fish is highly visible and valuable components of the freshwater ecosystems, fish communities have been applied to monitor river ecosystem health for a long time (Fausch et al., 1990; Plafkin, 1989; Simon, 1991). Fish are the top of the aqutic food web and are consumed by humans, which makes them important for assessing contamination (Barbour et al., 1999). Due to their relatively long life cycle and mobility, they can be good indicators of long-term (several years) effects and broad habitat conditions. In addition, with wide range of trophic level, including the highest level occupied by top predators, community structure of fish assemblage is reflective of integrated aquatic environment health (Karr, 1981; Karr et al., 1986; Harris, 1995; Shields et al., 1995). Fish communities respond significantly and predictably to almost all kinds of anthropogenic disturbances, including eutrophication, acidifition, chemical pollution, flow regulation, physical habitat alteration and fragmentation, human exploitation and introduced species. Their sensitivities to the health of surrounding aquatic environments form the basis for using fishes to monitor environmental degradation (Fausch et al., 1990). Over the last 30 years, a variety of fish-based biotic indices have been widely used to assess river quality, and the use of multimetric indices, inspired by the index of biotic integrity (IBI) has grown rapidly (Simon, 1999).

Advantages of using fish as a bioindicator:

- Fish are good indicators of long-term effects (several years) and habitat conditions.
- Fish communities represent a variety of trophic levels; toxic substances tend to biomagnify, and thus fish community structure reflects community health.
- Fish are consumed by humans.
- Fish are relatively easy to collect and identify.
- Environmental requirements, life history information and distribution are well known for most species. (Plafkin et al. 1989)

Extensive fish kills are indicative of severe oxygen depletion caused by organic pollution, oil slicks, or severe toxic pollution, including toxic bacteria or plankton. Erratic behavior, such as swimming close to the surface, slow movements, swimming in circles, and gasping for oxygen, are indicative of water contamination or severe oxygen depletion (De Lange 1994).

The efficacy of fish as individual bioindicator has been demonstrated by many studies, Fausch et al., (1990), Joy and Death (2002), Oberdorff et al., (2002), and Pont et al., (2006). In other studies, nevertheless, two or more assemblages have been used contemporaneously for monitoring river ecosystems, such as in Soininen and Könönen (2004), Scuri et al., (2006), Carlisle et al., (2008), Birk and Hering (2009), and Torrisi et al., (2010).

The diversity of fish offers the possibility to obtain an ecological overview of the current status of streams or rivers. The diversity has been measured using different diversity indices. In biomonitoring approaches, many diversity indices have been developed to describe responses of a community to environment variation, combining the three components of community structure, namely *richness* (number of species present), *evenness* (uniformity in the distribution of individuals among the species) and *abundance* (total number of individuals present) (e.g., Shannon-Wiener Index (Shannon and Weaver, 1949), Simpson Index (Simpson, 1949). The assumption is that undisturbed environments are characterized by high diversity or richness, an even distribution of individuals among the species, and moderate to high counts of individuals. The best use of diversity-related indices in river and stream monitoring is probably as an indicator of changes in species composition when comparing impacted and reference assemblages (Stevenson, 1984).

In India some studies have presented spatial and temporal trends in diversity or biotic index of streams, rivers and lakes (Chattopadhyay *et al.,* 1987; Jhingran *et al.,* 1989; Khanna, 1993; Verma *et al.*, 1978, Bhat, 2002). The biomonitoring system developed for the temperate streams was tested and found to be useful for the river Cauvery (Sivaramakrishnan, 1992; Sivramakrishnan *et al.,* 1996). The biomonitoring scores for the river Cauvery was developed by using, the modified form of standard table of Armitage *et al.,* (1983) developed for the Yamuna River (Trivedi, 1991; Sivaramakrishnan, 1992; Sivramakrishnan *et al.,* 1996). Still relatively little attention has been paid on the biomonitoring of Indian rivers (Rai, 1978; Jindal and Rumana, 2000; Jindal and Singh, 2006) hence the study of biomonitoring of Godavari river was carried out at Ambad.

The River Godavari is the largest of the peninsular rivers and the second longest river in India next only to Ganga. River Godavari is about 1,440 km (Jhingran, 1997) long from its origin near Trimbakeswar in Deolali Hills near Nashik (Maharashtra) in Northern Western Ghats to its tidal limits below Rajahmundry (Andhra Pradesh). It flows across the Deccan Plateau from Western to Eastern Ghats through Maharashtra and Andhra Pradesh before emptying into the Bay of Bengal. The catchment area of River Godavari is 315,980 km2 (Jhingran, 1997) to which Maharashtra contributes 48.6%, Andhra Pradesh (23.8%), Madhya Pradesh (20.7%), Orissa (5.5%) and Karnataka (1.4%). The river traverses 693 km in Maharashtra.

The river is considered to be one of the very sacred rivers of India. It is often referred to as the 'Vridha Ganga' or 'Dakshina Ganga'. The people believe that taking a holy dip in the river relieves them from all the sins. Being the ultimate sink of anything and everything drained through surface runoff, the river has been subjected to considerable stress. As a result, the water quality has been deteriorating day by day. Therefore, it is necessary to monitor and improve the river water quality using simple and effective methods.

Objectives worked out during the study period:

The study was carried out on Godavari river water at Ambad stretch, Jalna during July 2012 to May 2014 with the following objectives:

- To evaluate the physic-chemical properties of river water
- To study the seasonal variation in water quality parameters
- To study the fish biodiversity of river
- To study the fish diversity in relation to river water quality
- To identify the pollution sources and suggest the remedial measures for prevention and control of river water pollution

Methodology Used for the research work:

The study was carried out during July 2012 to May 2014. The water samples were collected from five sampling stations (Table 1) viz. Paithan being the reference site (unpolluted), followed by Balegaon, Gandhari, Shahagad-A and Shahagad-B in first week of every month consecutively for two years. The samples were analyzed in laboratory for different physical and chemical parameters as per the standard methods of APHA outlined by Trivedi and Goyal, 1986.

Table 1. Details of sampling stations with code and geographical position

Sampling Station	Code	Geographical Position
Paithan (Reference site)	R	$19^0$29.083" N, $75^0$22.408" E
Balegaon	A	19^o23'17.5"N,75^o36'54.0"E
Gandhari	B	19^o22'05.4"N,75^o40'21.5"E
Shahagad-A	C	19^o22'32.3"N,75^o43'21.0"E
Shahagad -B	D	19^o22'35.4"N,75^o43'29.5"E

Fish samples were collected seasonally viz. monsoon, winter and summer for both years at each sampling station. The fish specimens were identified according to Mishra (1962), Jayaram (1981; 1999; 2006), Fischer and Bianchi (1984), Talwar and Jhingran (1991), and Jhingran (1997).

The diversity of the fish collected at each sampling station was calculated by adopting Shannon indices (Shannon and Weaver, 1949). The obtained results were statistically analyzed for significance.

Organization of the work

The outputs of the present research work were summarized in six chapters as follows.

Topic–I: Introduction - The introduction of the research work will summarized in this topic and its national and international status will be given in it, along with review of literature and why problem has been selected.

Topic–II: Review of literature- The relevant work done by other workers in the field related to the research topic will be summarized in this topic.

Topic–III: Materials and methods - The details of study area, The samples were analyzed in laboratory for different physical and chemical parameters as per the standard methods of APHA outlined by Trivedi and Goyal, 1986.

[Ph,Temperature,Turbidity,TH,TDS,TA,Chlorides,Nitrate,Phosphate,DO,BOD,COD]were studied Fish samples were collected seasonally viz. monsoon, winter and summer for both years at each sampling station. The fish specimens were identified according to Mishra (1962), Jayaram (1981; 1999; 2006), Fischer and Bianchi (1984), Talwar and Jhingran (1991), and Jhingran (1997).The diversity of the fish collected at each sampling station was calculated by adopting Shannon indices (Shannon and Weaver, 1949). The obtained results were statistically analyzed for significance.

Topic-IV: Results: The results will be summarized in this fourth chapter.

Topic–V: Discussion: The results of work will be discussed with appropriate references by giving suitable reasoning. The summary and conclusion will be endorsed at the end of this topic with recommendations.

Topic–VI: References: The cited references in introduction, materials & methods, and discussion will be summarized in this topic.

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